6. The bleaching of colours takes place less rapidly when the colours are in solution than when they are dyed on fabrics.

7. The bleaching of colours in solution takes place less rapidly if the living germs or organisms in the solutions are destroyed by boiling than if they be not so destroyed.

8. The bleaching action of light appears to be more powerful if the colours are in contact with an organic fabric than if they are used to colour inorganic materials (asbestus).

9. The bleaching action of light in presence of air is much facilitated by the presence of moisture in contact with the colours and more particularly of *evaporating* water in contact with dyed fabrics.

10. There can therefore be little doubt that the bleaching action of light on ordinary organic colouring matters is usually due to oxidation. This oxidation when facilitated by evaporating water is probably or almost certainly due to the action of ozone, for Gorup von Besanez has shown that ozone is invariably formed when water evaporates in the air.* It therefore appears highly probable also that the action of the sunlight on the oxygen of the air *brings it into an active condition* (resembling perhaps that of ozone), and that the bleaching of organic colours is due to oxidation from this cause; for ordinary oxygen uninfluenced by sunlight does not bleach.

No. 3. *Notes on, and drawings of, the animals of various Indian Land Mollusca (Pulmonifera).*—*By* Lieut.-Colonel H. H. Godwin-Austen, F.R.S., F.Z.S., &c.

[Read 3rd April.]

Plate VII.

Continued from J. A. S. B., Pt. ii., Vol. LI, 1882, *p.* 71.

After the long lapse of 12 years since publishing my second paper (in 1882), on the drawings of Indian Land-Mollusca made by native artists under the superintendence of Ferdinand Stoliczka, I now forward a third, with the hope that it will lead some of our younger naturalists to make notes and drawings, and if possible dissections, of Indian species, so that they may be more accurately placed in generic position.

The first I have to notice and reproduce on Plate vii, fig. 1, is No. 29 of Ferd. Stoliczka's drawings, a very careful and accurate one of *Helix octhoplax*, with his MS. note attached,—"Asalu; sent down by Major Godwin-Austen." In 1869 I was surveying in the Naga Hills and

* Ann. Chem. Pharm. clxi. 232; also Roscoe and Schorlemmer Treatise on Chemistry Vol. I., p. 200.

was able to send a large number of species alive to Calcutta, by packing them in hollow green bamboos. In this way they travel well. No wet moss is necessary, and should be excluded. Green leaves or grass are best, and with the present rapid transit they might in the autumn months reach England in safety. A collection made in Aden reached me all in a living state, and survived a long time, and bred, being viviparous.

Sub-family *Helicea.*

Sub-Genus Eucochlias, Theobald.

Catalogue Land and Freshwater Shells of British India, August 1876, p. 26. No description is given, so I add one below.

Type of genus Helix octhoplax, Benson. Plate VII. fig. 1.

Annals and Mag. Nat. Hist., Sept. 1860. from Pegu, (Theobald).

Description of Genus.

Animal.—A true *Helix*; jaw grooved (according to W. T. Blanford, *vide* Nevill's Hand List, p. 81); foot very flat and oval when fully extended; tentacles rather thick, surface granulate, no defined pallial line.

Shell.—Large, solid, closely umbilicated, depressed, convex above and below, keeled, aperture broadly lunate, peristome slightly expanded, reflected near the short solid columella, margins joined by a slight callus. Ranges from the North Khasi Hills eastward. Theobald gives Moyang Khasi Hills as the habitat, and as the type shell described by Benson came from him, Pegu, I think, must be a mistake.

Description of *H. octhoplax* from Moyang, northern side of the Khasi Hills, in my note book: "of a rich dark madder brown colour, base of foot and its narrow edge of same colour but lighter, when partially withdrawn into shell the foot is much flattened and crinkled up along the margin, foot rounded at extremity with no gland above." In the drawing of the animal there is a well marked pale line on the dorsal side of the neck, formed by three strong parallel rugæ or lines, broken up into large tubercles.

This is a very distinct genus, and the animal of very striking and beautiful appearance, if we can apply such a term of praise to a snail, and it is unlike any other *Helix* I have seen in this part of India. It is very rare and local on the North-East Frontier, and I never obtained it on the south of the water-parting. I have it from the north of the Garo Hills, Moyang in the Khasi Hills, and Asalu in the Naga Hills.

Nevill suggests in his Hand List, that it "is probably closely allied to *Stylodon* (*Stylodonta*?) possibly not separable." This can only be settled after a comparative examination of the anatomy of the animals. It would certainly be a very interesting fact with regard to distribution, to find a genus of the Seychelle Islands extending to Eastern India. I hope before long to receive specimens in spirit from the Khasi Hills. *E. illustris* Pfr. from Cambodia is very close to *E. octhoplax*, and Nevill includes *bougainvillei*, Pfr. from the Solomon Islands. Benson taking shell characters alone into consideration and, no doubt, thinking it one of the *Zonitidæ*, placed it near *cycloplax* of Sikkim.

It grows to a large size. My finest specimen measures, major diam. 61·0, minor diam. 51·0, alt. axis 25·0 millim.

Benson's type measures, major diam. 46, minor diam. 26, alt. axis 25·0 millim.

Since commencing this paper I have received another and distinct species of this genus, from my old friend and former assistant in the Indian Survey Department, Colonel Woodthorpe, C.B., who got it on the eastern frontier of Burmah, beyond Fort Stedman; and I am about to describe it in the Annals and Magazine of Natural History. It is preserved in spirit, so that I have been enabled to examine its anatomy. It appears to me far nearer to such forms of *Cochlostyla* as *C. cineracea*, Semper; and if I should be correct in this view, it would be an interesting extension westward of that group of shells.

Genus Plectopylis, Benson, Type *achatina*, Gray.

Annals and Mag. Nat. Hist., April 1860.*

This genus has been treated of by Mr. W. T. Blanford, in Annals and Mag. Nat. Hist., April 1861, and J. A. S. B., Vol. XXXIV, 1865, p. 73. In the P. Z. S., November 1874 and January 1875, and in this Journal for 1879, a number of species both old and new were described and figured with some detail by myself, especially as regards the very peculiar and characteristic internal plication.

This genus is anatomically described most admirably by F. Stoliczka from the type species, in this Journal for 1871, p. 217. How far it differs from *Corilla* of Ceylon, to which it must be closely allied, has still to be made out; as also the true affinity with *retifera* from the Nilgherries, and with *clathratula* from Ceylon, which is still more remote.

Stoliczka, from his observation and knowledge of the animal, considered this genus related to *Clausilia*. The genus is ovo-viviparous as observed in three species—*achatina*, *cyclaspis* and *pinacis*—jaw grooved.

* Fig. 56 of Stoliczka's Drawings, Moulmain, Pl. vii. fig. 5.

Helix (Plectopylis) minor, Godwin-Austen. Plate VII. figs. 3 and 3a. (No. 51 of MS. Stol.).

Described in Annals and Mag. Nat. Hist., August 1879. Darjiling?

I give below a copy of the original description and add the dimensions then omitted. I now also give magnified drawings of the hair-like epidermal fringe in this species (fig. 3a) and in another allied to it, also from Darjiling, *P. pinacis* (fig. 2a), in which it is seen how greatly they differ, being regular and symmetrical in size and diameter and perfectly rounded at the end in *P. minor*; while in the other it is irregular flattened and divided near the extremity into two or more points, which are again split at the end. This distinction held good in both young and old specimens and was not the result of age or weathering.

It may be interesting here to refer to Plate I, J. A. S., B., 1879, where the epidermal fringe of *P. brachydiscus* is given, shewing another and very distinct form of hairy fringe.

Description. "Shell sinistral, openly umbilicated, discoidal, hirsute. Sculpture coarse with irregular transverse ribbing, near the apex fine and regular ribbing; color pale umber, with regularly disposed broadish transverse bars of sienna-brown: spire flat, only the first three whorls slightly rising above the others; suture shallow. Whorls five, sub-angular on the periphery of the last, which has four distinct rows of short hairs, entire at the point. Aperture oblique, slightly descending; peristome lunate, slightly flattened on the upper outer margin, but very little reflected, the inner margins connected with a distinct bridge on the parietal side. The parietal vertical lamina is simple, with no distinct horizontal plica below it, as in *macromphalus*; the palatal plicæ are six in front, four behind, the basal one in front thin, and longer than the others."

Major diam. 0·20 in., minor diam. 0·17 in. alt. axis 0·09 inch.
„ „ 5·0 mm. „ „ 4·5 mm. „ „ 2·3 mm.

The animal in Stoliczka's drawing now before me is coloured dark brown, and being a young shell is enlarged. In my MS. notes I find a specimen of *P. macromphalus* from Shillong in the Khasi Hills thus described: "Animal with lower tentacles represented by two small hemispherical protuberances, body all pale with tinge of orange on head and neck: extremity of foot pointed." I must now correct an error in my paper in the Annals and Magazine of Natural History for 1879, where I say that in Stoliczka's drawing it is represented of a pink color.

The animal of *P. plectostoma*, Bs., from Teria Ghat, is thus described in my field book:—"Animal: foot short, of a pale brown yellow

tint, neck and tentacles the same slightly darker; tentacles short, the oral very small; no gland on foot, which is pointed."

Helix (Plectopylis) achatina. Gray. Plate VII. fig. 5.

Moulmain ? (fig. 56 of MS. Stol.)

Description from drawing.—Animal with long slender eye-tentacles, the oral of ordinary size; colour of tentacles and neck dark umber brown, pale towards the extremity of the foot, which is pointed, very minutely speckled with brown throughout: a broad pale pedal margin, or fringe, distinctly defined by a line of oblong tubercles apparently similar to what is seen in the *Zonitidæ*, but there is no mucous gland at the extremity of the foot.

Helix huttoni, Pfr.

(Fig. 23 of the drawings: no remarks.)

No locality is given; but as the drawing was made on a piece of cardboard on which were two other shells from Darjiling, I imagine it was collected there. I note also that Mr. G. Nevill in his Hand List, gives 30 specimens in the Indian Museum from Darjiling, and in Mr. W. T. Blandford's collection are specimens from the same locality.

In the drawing the animal is shewn nearly pure white including the tentacles, with a pointed extremity to the foot, the pedal margin distinct.

Now true *Helix huttoni*, which was described from the N. W. Himalaya, is very differently described in my Notes on specimens from Waverley, Mussoorie Hill Station:—"Animal light brown, tentacles long and dark brown;" it is doubtful therefore, whether the N. W. Himalayan and the Darjiling species are identical. The former also have a much more hairy, rougher epidermis than those so called *huttoni* from the latter place and the Khasi Hills.

Mr. Theobald placed this species in the genus *Fruticicola* Helder (=*Hygroucia*, Risso, *apud* Adam's genera) of which the European *H. hispida* is the type, and to which in shell structure it closely assimilates. It is just as well in our present state of ignorance of the animal to leave *H. huttoni* in the sub-genus *Fruticicola*, of which the animal is known, rather than in *Plectotropis* of Albers founded on the shell only (of *elegantissima*) from the Liew-Kiew Islands, or in *Planispira*, Beck (type *zonaria*) from Celebes (=*Eurystoma*, Albers, type *vittata*) from Ceylon. We should also be guided somewhat by the known, or rather reputed distribution of *Fruticicola;* which ranges from the European region into Asia and is represented by *rufispira*, Von Martens, in Turkestan; by *plecto-*

tropis and *phæozona*, V. Martens, Sásak Taka; *dschulfensis* in Persia; and by *bactriana*, Hutton, from Kandahar; which carries it close into the Himalayan range. Nevill also describes one (*mataianensis*) from Mataian, Sind Valley, Kashmir.

Helix similaris and *bolus* which have been placed in the genus *Fruticicola* have, I should say, but very slight connection with it. The list of species in *Planispira* and *Plectotropis*, as given by Geoffrey Nevill in the Hand List, will require very considerable revision. In an unpublished copy of his Hand List, greatly corrected, which he was good enough to give me before his early death, he has put *H. huttoni* in *Aegista*, a genus of Albers, who placed in it *Helix oldhami* from Burma, a very different form as regards the aperture of the shell.

Until we know the anatomy of *Eurystoma vittata*, *Plectotropis elegantissima* and *Aegista oculus* from China, it is unsatisfactory work trying to place these Indian species under any of these three genera; and it is very difficult to get hold of the type species in spirit.

Sub-genus Planispira, Beck.

(Type *Zonaria*, Müller from Celebes.)

Eurystoma, Albers (on shell alone), type *H. vittata*, Ferussac, from Madras.

Semi-cornu, Klein.

H. (? *Planispira*) *propinqua*, Pfr. Plate VII, fig. 4.

Central India (fig. 40 of MSS. Stol.)

The remarks which I have made regarding the location of Indian species in this genus, applies here to this one. An examination lately made of the anatomy of some Southern Indian Shells (and I am expecting some more material) shews that a number of them are very closely related, although they do not shew it in shell character.

Description of Plate.

Fig. 1. Animal of Helix (Eucochlias) octhoplax, Benson.
2. Animal of Helix (Plectopylis) pinacis, Benson.
2*a*. Epidermal hairs on keel magnified.
3. Animal of Helix (Plectopylis) minor, G.-A.
3*a*. Epidermal hairs of same magnified.
4. Animal of Helix (Planispira ?) propinqua. Pfr.
5. Animal of Helix (Plectopylis) achatina. Gray.

2a

1

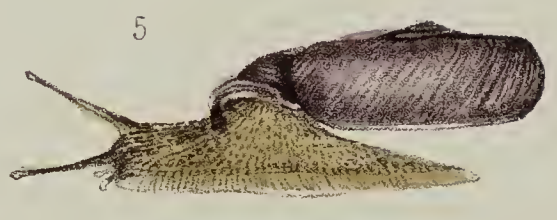
2

3a

4

3

5



INDIAN LAND SHELLS.